INSTRUCTIONS

MODEL 1452
DIGITAL RECORDER

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ELECTRONIC INSTRUMENTS DIVISION
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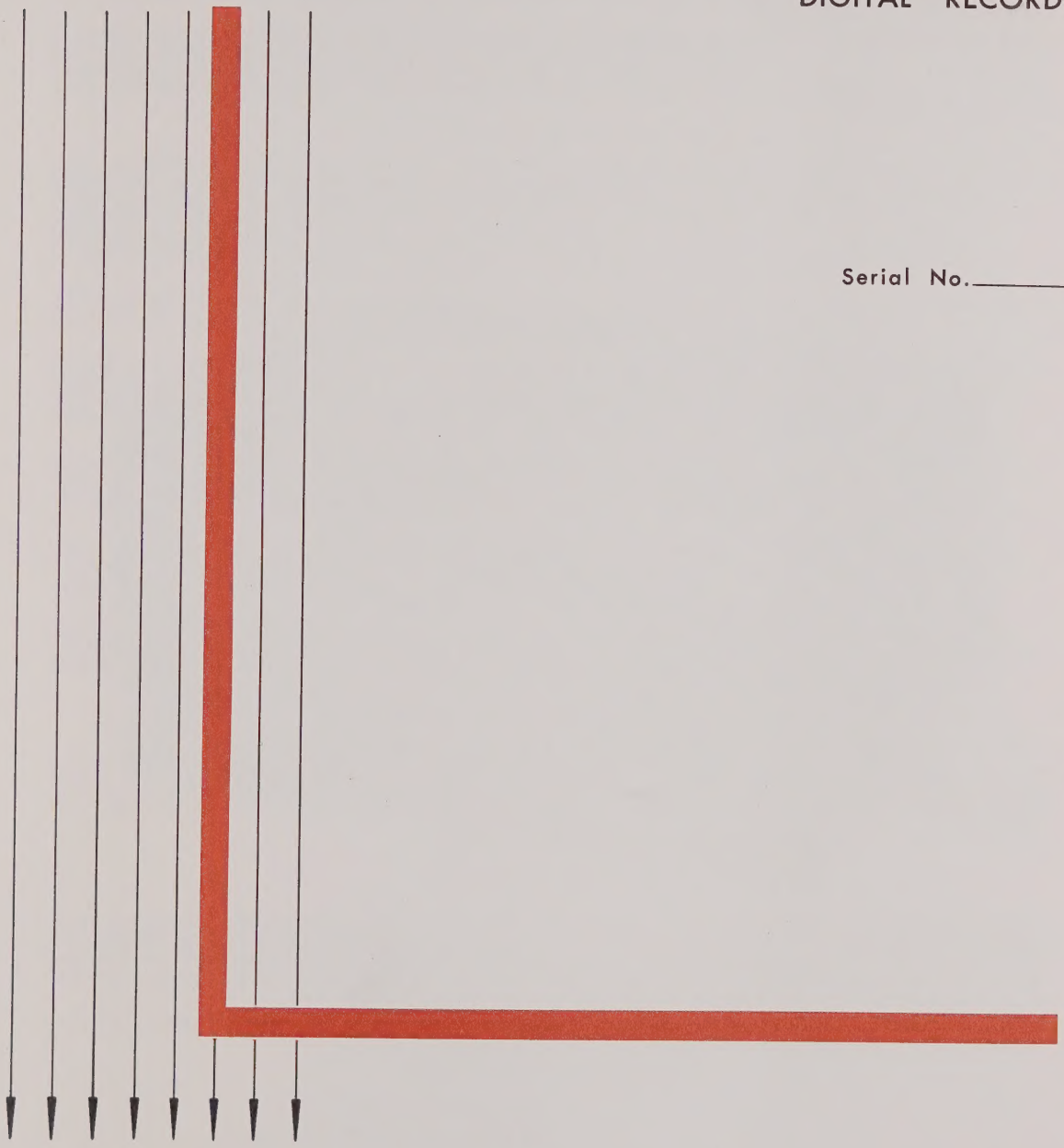
INSTRUCTION MANUAL

MODEL 1452
DIGITAL RECORDER

Serial No._____



Beckman® INSTRUMENTS, INC.

BERKELEY DIVISION
2200 Wright Avenue
Richmond, California

1960

WARRANTY

Instruments sold by Berkeley Division, Beckman Instruments, Inc., (hereafter called "the Company") are warranted only as stated below.

Subject to the exceptions and upon the conditions specified below, the Company agrees to correct, either by repair, or, at its election, by replacement, any defect of material or workmanship which develops within one year after delivery of the instrument to the original purchaser by the Company or by an authorized representative, provided that investigation and factory inspection by the Company discloses that such defect developed under normal and proper use.

The exceptions and conditions mentioned above are the following:

(a) Some components and accessories by their nature are not intended to, and will not, function one year. If any such component or accessory manufactured by the Company and part of the item sold fails to give reasonable service for a reasonable period of time, the Company will, at its election, replace or repair such component or accessory. What constitutes reasonable service and what constitutes a reasonable period of time shall be determined solely by the Company after the Company is in posession of all the facts concerning operating conditions and other pertinent factors and after such component or accessory has been returned to the Company, transportation prepaid.

(b) All instruments claimed defective must be returned to the Company, transportation charges prepaid, and will be returned to the customer with the transportation charges collect, unless the item is found to be defective in which case the Company will pay all transportation charges.

(c) The Company makes no warranty concerning components or accessories not manufactured by it, such as tubes, fuses, batteries, etc. However, in the event of the failure of any component or accessory not manufactured by the Company, the Company will give reasonable assistance to the purchaser in obtaining from the respective manufacturer whatever adjustment is reasonable in the light of the manufacturer's own warranty.

(d) Except as stated above, the Company makes no warranty, express or implied (either in fact or by operation of law), statutory or otherwise; and, except to the extent stated above, the Company shall have no liability under any warranty, express or implied (either in fact or by operation of law), statutory or otherwise.

(e) The Company expressly disclaims any liability to its customers, dealers, and to users of its products, and to any other person or persons for consequential damages of any kind and from any cause whatsoever arising out of or in any way connected with the manufacture, sale, repair, replacement of, or arising out of or in any way connected with the use of any of its products.

(f) Representations and warranties made by any person, including representatives of the Company, which are inconsistent or in conflict with the terms of this warranty (including but not limited to the limitation of the liability of the Company as set forth above) shall not be binding upon the Company unless reduced to writing and approved by an officer of the Company.

(g) This warranty shall be governed by the laws of the State of California.

Claims for damage in shipment should be filed promptly with the transportation company.

All correspondence concerning the instrument should specify the model and serial number. This information appears on the company name plate. Any inquiry concerning details of operation, possible modifications, etc., should be addressed to the Sales Department, Berkeley division of Beckman Instruments, Inc., Richmond 4, California.

REPAIR SERVICE

Experienced service personnel and special test equipment are available at the factory to perform any necessary repairs. Every effort will be made to expedite the repair of instruments returned for servicing. Repair work will be performed only upon receipt of a written purchase order or authorization. Instruments to be repaired should be addressed to SERVICE AND REPAIR DEPARTMENT with transportation charges prepaid. Repaired instruments will be returned to the purchaser with transportation charges collect.

Berkeley reserves the right to make changes in design at any time without incurring any obligation to modify equipment previously purchased to conform to subsequent design changes.

BERKELEY DIVISION
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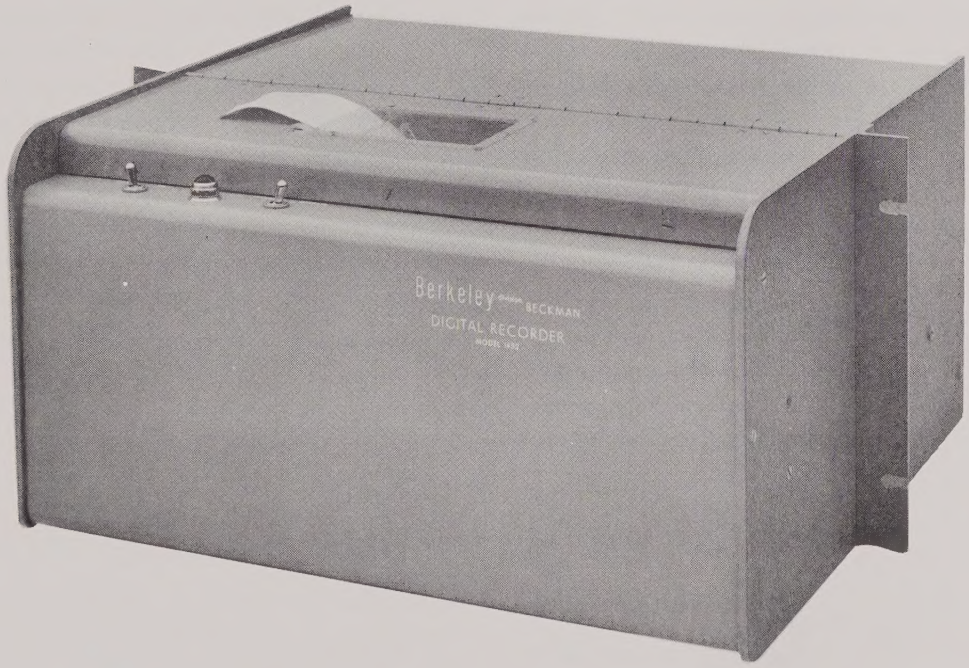

MODEL 1452 WITH SIDE BRACKETS ATTACHED FOR RACK MOUNTING

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INTRODUCTION

GENERAL DESCRIPTION

The Berkeley Digital Recorder Model 1452 provides a simple, reliable method of converting electronic count information into printed form. This unit can be coupled directly to any new Berkeley electronic counting device having a 4-line modified binary code available from each decade. It will print sequentially in Arabic numerals on a standard adding machine tape the total count accumulated by the basic instrument during each of its counting periods. The Model 1452 may be used for long term stability checks, recording of transients, or for making a permanent record in digital control systems. Information which otherwise requires observation and manual recording is automatically printed as a matter of permanent record.

The Recorder is designed to operate directly from Berkeley Events-Per-Unit-Time Meters, Time Interval Meters, Electronic Counters and Nuclear Scalers which have a 4-line code available from each decade. Most new Berkeley instruments have this 4-line code available and provision is made for direct connection to the Model 1452. Most Berkeley counting equipment now in the field can be adapted for such operation.

Modification A adds a feed and storage box, which accommodate an accordian folded tape. Tape so folded is easily stored and count information for any period may be located quickly by paging through the folded tape as though it were a book.

SPECIFICATIONS

Recording and Indicating Capacity	7 digits standard, 8 or 10 digits on special instruments
Maximum Cycling Rate:	1 printout every 0.9 seconds
Counting Period, Range and Accuracy	Determined by the characteristics of the basic counting instrument
Visual Display Time	Controlled by the basic counting instrument
Power Requirements	100-130 volts, 50-60 cycles, approx. 65 watts
Input Requirements:	Four-line code from the basic counting unit.
Cable Length	Six feet standard. Special lengths available
Dimensions	Without cabinet: 7" wide, 7" high, 8" deep With cabinet: 9" wide, 8-1/2" high, 18" deep
Weight	Without cabinet: 50 lbs. With cabinet: 70 lbs.

OPERATION

INSTALLATION

Satisfactory service may be obtained in any location where the ambient temperature is between 25° and 180° F. To permit the Digital Recorder keyboard and paper feed to function correctly the instrument must be operated only in a horizontal position. The printer chassis rests on shock mounts which have been locked for shipping. Release the lock by removing the two screws on the printer baseplate identified by black washers.

OPERATING PROCEDURE

Operation is exceptionally simple. Connect the cable from the Digital Recorder to the proper accessory socket of the electronic counter and plug in the power line to the recorder. Turn the OFF-ON switch to ON and allow the recorder to warm up for a minute. Place the STANDBY-OPERATE switch at STANDBY and adjust the counter to obtain the desired operation. Then switch the recorder to OPERATE. A continuous chain of information will be printed if the electronic counter is operating automatically. The STANDBY position can be used to hold the printing action until the physical quantity under test reaches stability. On the other hand, a permanent record of fluctuations observed as the physical quantity under test comes to a stability may be obtained in the OPERATE position.

NOTE

If the recorder is to be operated with a 5-digit or 6-digit counter purchased before July 1957, it will be necessary to re-wire the DIGITAL RECORDER socket slightly to prevent the recorder from printing a seventh, irrelevant digit. The change consists only of connecting pins 25, 26, 27 and 28 to pin 36.

OVER-ALL DESIGN

The recorder is made up of five basic elements:

1. A four-pole stepping switch which scans the coded readout line from the DCU's in the counter.
2. A relay-matrix decoder which sets up a digit in the printer corresponding to the code received from each DCU.
3. A solenoid operated ten-key printer (a Victor adding machine with accumulator removed to permit it to operate faster.)
4. Control relays which govern the internal action of the recorder and synchronize the recorder with the counter.
5. A power supply.

Figure 1 is a block diagram of the recorder. When the counter has completed a count it sends a control signal which starts the recorder cycle if and when the previous cycle is completed. The stepping switch electrically scans the readout lines of each DCU in turn beginning with the one which displays the highest order digit. The four readout lines from each DCU carry a combination of positive and negative voltages which represent the digit displayed. This information is applied through four buffer triodes to the four relays of the relay matrix decoder. The relays establish a path through the decoder matrix which carries an actuating voltage to that printer solenoid which sets up the digit displayed by the DCU. After all the DCU's have been scanned the stepping switch picks up a 4 line "print" code which establishes a path through the matrix which carries the actuating voltage to a solenoid which causes the printing motion. When the printing action begins, a line to the counter which has been grounded to inhibit the reset action during scanning is ungrounded, permitting the counter to reset when ready. The counter resets and begins another count. If this new count is completed before the previous count has been printed, the "Inhibit Reset" line is once again grounded to prevent reset until the new count has been scanned.

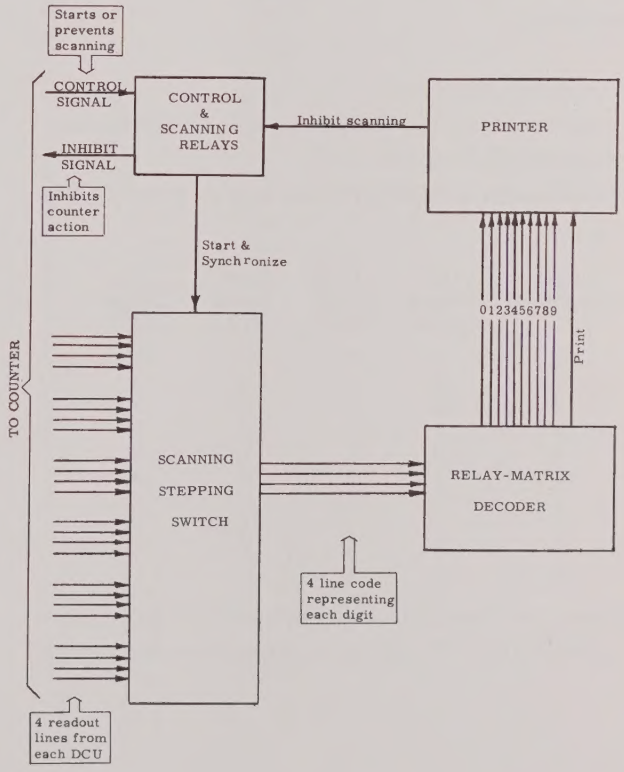


FIGURE 1.
BLOCK DIAGRAM OF RECORDER

DECODING CIRCUITRY (THE RELAY MATRIX)

After the counter has finished a counting period and is displaying the total count, the coded count information goes to the stepping switch contacts in the recorder.

Four readout lines from the four stages of each DCU carry a combination of positive and negative voltages which represent the digit indicated. (See Figure 2.) When the stepping switch is at a contact position to read a particular DCU, these voltages are each coupled to a grid of one of the buffer triodes. A positive voltage causes the triode to conduct and energize its associated coil in the relay matrix. A negative voltage cuts off the triode and de-energizes the coil. The combination of energized and de-energized relays creates a path through the matrix which leads to the printer solenoid which sets up the indicated digit to be printed.

The code is as follows:

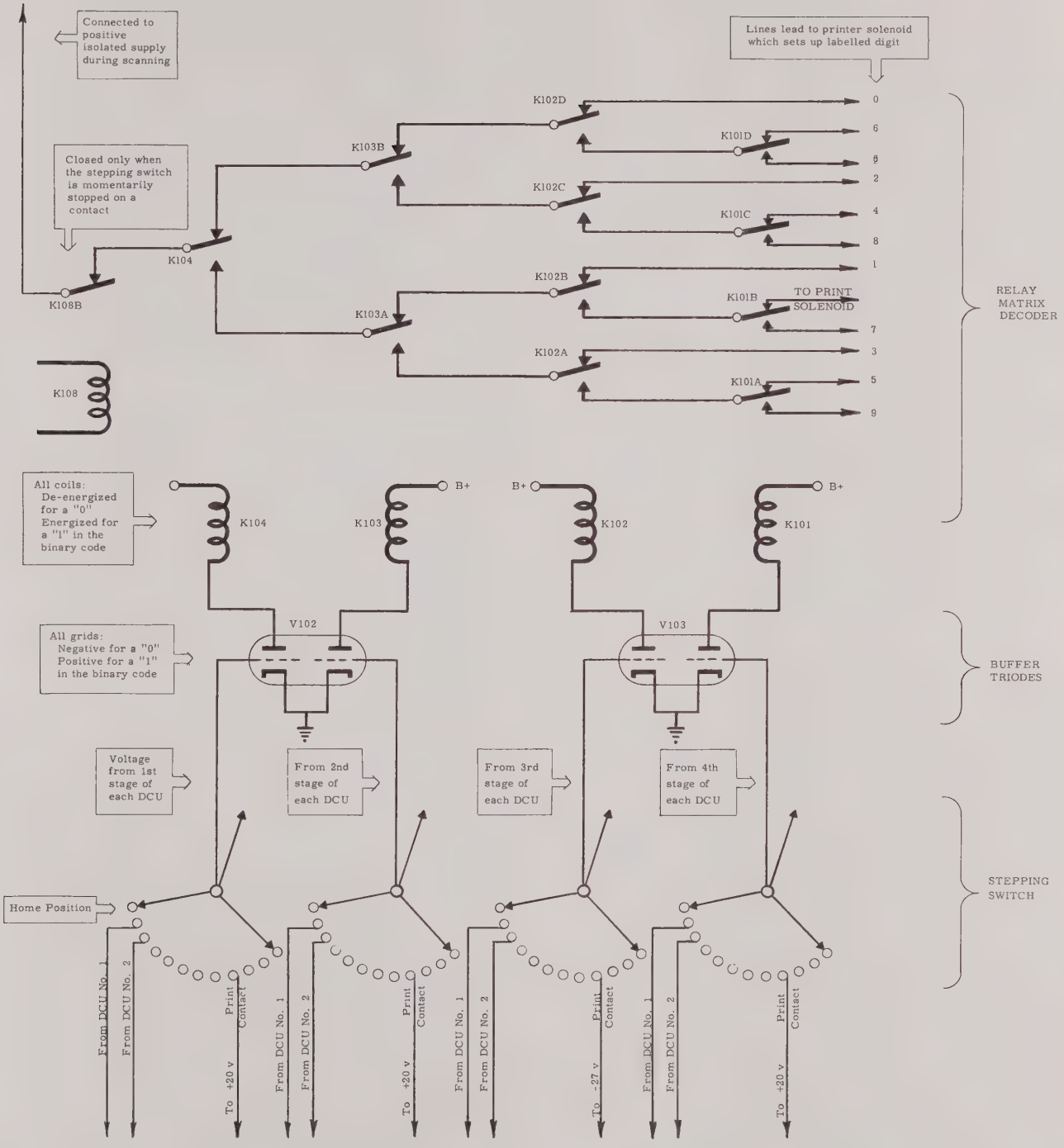
"0" represents a NEGATIVE readout line and a DE-ENERGIZED matrix relay.

"1" represents a POSITIVE line and an ENERGIZED relay.

Digit Displayed	1st Stage K104	2nd Stage K103	3rd Stage K102	4th Stage K101
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	1	1	0
5	1	1	1	0
6	0	0	1	1
7	1	0	1	1
8	0	1	1	1
9	1	1	1	1

Suppose, for example, that the first DCU in the counter is indicating "7" and that a wiper on each layer of the stepping switch is momentarily stopped on the contact leading to this DCU. In this state the first stage of the DCU is positive at the point where the readout line is connected, the second stage is negative at this point and the third and fourth stages are positive. (As the code table indicates this combination of voltages is coded 1011.) The positive voltage from the first stage is conducted through one layer of the stepping switch to the left grid of V102. That half of the tube conducts energizing K104 which depresses its relay armature. The negative voltage from the second stage is coupled to the right grid of V102 cutting that half off so that K103 is de-energized and K103A & B take their normal positions. Similarly, the positive voltages from the third and fourth stages cause K102 and K101 to be energized. This combination of energized and de-energized coils creates a path through the relay matrix from K104 to K103A to K102B to K101B to the line leading to the printer coil which sets up a "7" to be printed. At some time while the relays are in this stage K108 is de-energized and K108B is closed so that an actuating voltage is conducted along the path energizing the printer coil.

The four print contacts are connected to the positive or negative supply voltages to create the code 1101. When the stepping switch wipers reach these contacts, a path is created to the print solenoid which energizes, thus printing the digits which have been set up. At each of the last four positions of the stepping switch the contacts are connected to positive or negative supply voltages which produce the code 0101. When the relays are energized according to this code, there is no path through the matrix to the printer.



NOTES: DCU's are numbered from left to right as seen on the front panel of the counter.
The stepping switch is shown in the home position.

FIGURE 2. SIMPLIFIED DIAGRAM OF DECODING CIRCUITRY

SCANNING CIRCUITRY (THE STEPPING SWITCH)

The stepping switch scans the count information on the DCU's in the counter and conveys the coded count to the relay matrix. Starting from a "home" position the switch moves successively to eleven positions; the first seven couple it successively to each DCU in the counter, in the eighth it picks up a code which causes the printer to print, and the last three are traversed merely to bring it to the eleventh or "home" position. Scanning is completed and printing begins when the switch reaches the eighth position. If the counter contains only six DCU's, it will deliver the "no digit" code (0010) at the first position; if only five DCU's, the "no digit" code will appear at the first and seventh positions, and so on. The circuitry shown in Figure 3 initiates the scanning action, slows the stepping speed, and applies power through the relay matrix to a printer solenoid only when the stepping switch is momentarily stopped and supplying a voltage code to the matrix.

Before the scanning action starts the stepping switch is at rest in the "home" position. The off-normal switch which is mechanically attached to the stepping switch is open only in this position. When power is supplied to the relay combination K107 & K108, the switch begins to step, closing the off-normal switch and continuing to step until it again reaches the "home" position. Initially, power is supplied to the relay combination through K106C and K109B. When the previous count has been printed and the next count has been taken by the counter, K106 and K109 are de-energized and both K106C and K109B are closed.

When the power reaches the relay combination the following cycle occurs:

1. Since K108A is closed K107 is energized.
2. A contact on K107 closes energizing K108 (The opening contacts on K107 merely interpose a voltage dropping resistor (R124) between the negative supply and the K107 coil. K107 remains energized.)
3. K108A opens de-energizing K107.
4. A contact on K107 opens de-energizing K108.
5. K108A closes and the sequence is repeated.

The stepping switch moves one step for each cycle. At time 3, when K107 is de-energized, a spring moves the switch to the next contact position. While the switch is moving K108 remains energized by the discharge of C105. This holds K108B open during the movement so that no power is applied to the relay matrix. At time 1 the switch is momentarily at rest, the four line code from one of the DCU's establishes a path through the relay matrix and power is conducted through K108B along the established path to the appropriate printer solenoid.

When the stepping switch reaches the eighth position the "print" key solenoid is energized and the printer begins to print. A switch on the printer energizes K105 which disconnects C105 from across K108. The removal of the capacitor permits K108 to energize and de-energize more rapidly so that the stepping switch traverses the last three unused contact positions quickly and reaches the "home" position where it stops ready to scan the next count.

CONTROL RELAYS (K106, K109 & K105)

These relays synchronize the action of the counter, the scanning stepping switch and the printer. A simplified diagram of the circuitry appears in Figure 5. To understand the operation of these relays consider first the cyclic action of the counter and recorder and the controls between them required if the recorder is to perform its function.

The counter cycle may be divided into two periods:

1. The period between resetting and completing another count.
2. The period in which the DCU's hold the accumulated count (the display period).

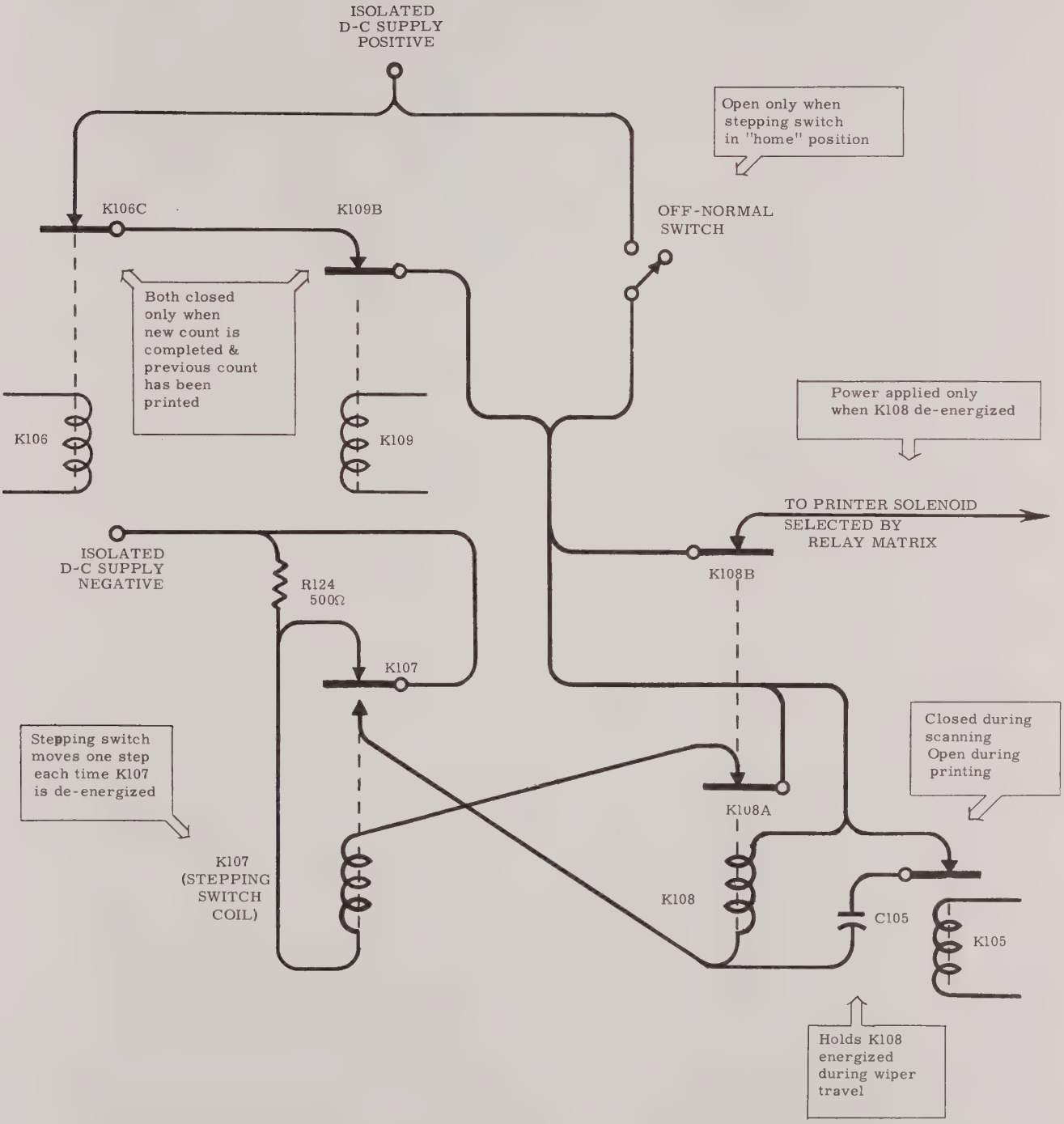


FIGURE 3. SIMPLIFIED DIAGRAM OF SCANNING RELAYS

The recorder cycle consists of:

1. The scanning period, during which count information is collected and entered into the printer.
2. The printing period, the time taken to print the count entered on paper tape.

The recorder must scan only during the display period, and it must not begin scanning until printing is completed so that the printer will be free to receive count information. Therefore, a control signal from the counter to V101 prevents scanning during counting and causes scanning to start after counting provided a signal from the printer indicates that printing is completed. Furthermore, the counter must not reset, destroying the accumulated count information, until the count has been scanned. Therefore, a line leading to the counter is provided which inhibits the reset action when grounded. This line is grounded by K106B in the interval (if any) between the end of the counting period and the beginning of scanning and by K109A during scanning.

Operating Sequence

The following sequence occurs when the counter is operating automatically and the recorder is printing each count. (Which of the alternate actions takes place depends upon the duration of the counting period and the length of the display time adjusted on the counter.) An arrow leading from one event to another means that the first causes the second.

1. From the previous reset to the end of the counting period the input grid of V101 is positive.
   - → The tube conducts
     - → K106 is energized
       - → K106C is open
         - → Scanning cannot begin

2. From the end of the counting period until reset, the input grid of V101 is negative. Assuming the recorder is not printing a previous count K109 is de-energized, K109C is closed and the other grid is also negative.
   - (1) The tube is cut-off
     - → K106 is de-energized
       - → K106C is closed
   - (2) K109C is closed
   - (3) Therefore, K106C and K109B conduct power to the relay combination K107 & K108, initiating scanning.

DURING SCANNING

- K105 is de-energized
  - → K105C is open
    - → K109 is de-energized
      - → K109A is closed
        - → The "Inhibit Reset" line is grounded
          - → The counter cannot reset

NOTE: Scanning is described separately under "THE SCANNING ACTION"

3. At the end of scanning printing begins

DURING PRINTING & SIMULTANEOUS DISPLAY OF COUNT BEING PRINTED

(1) Contacts on the printer are closed
→ K105 is energized
→ K105C is closed
→ K109 is energized
→ K109A is open

(2) K106B is open. (See step 2 above)

(3) Therefore, the "Inhibit" line is ungrounded
The counter may reset

IF THE COUNTER RESETS DURING PRINTING (Timing Diagram A)

4A. At reset the input grid of V101 goes positive
→ The tube conducts
→ K106 is energized
→ K106B grounds the "Inhibit" line permitting counting to start in some Berkeley instruments. (In some instruments counting starts at the end of a "delay start" time set by the counter)

5A. The next count begins

IF THE NEXT COUNT ENDS WHILE THE PREVIOUS COUNT IS BEING PRINTED (Timing Diagram A_1)

$6A_1$ At the end of the counting period the input grid of V101 goes negative but K106 is latched energized by K106A which grounds the other grid of V101, permitting the tube to conduct
→ K106B is closed
→ The "Inhibit" line is grounded
→ The counter cannot reset again

$7A_1$ At the end of printing contacts on the printer are opened
→ K105 is de-energized
→ K105C opens
→ K109 is de-energized
→ K109C is closed. The grid of V101 is driven negative
→ K106 is unlatched

$8A_1$ The action is repeated from step 2.

IF PRINTING ENDS BEFORE THE COUNTER RESETS (Timing Diagram B)

4B. At the end of printing K105 is de-energized but K109 is latched energized by K106C (See Step 2.) and K109B. K109A remains open.
→ The "Inhibit" line is still ungrounded

5B. The counter resets and the action is repeated from step 1 above

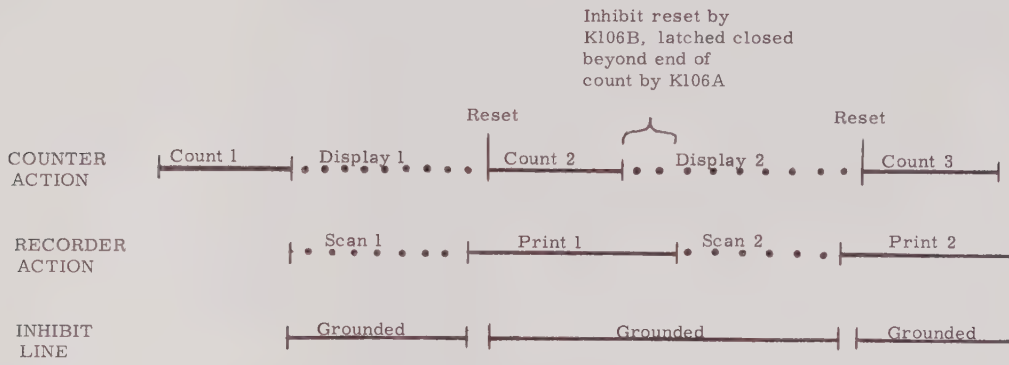
IF PRINTING ENDS DURING THE NEXT COUNT (Timing Diagram A_2)

$6A_2$ At the end of printing contacts on the printer are opened.
→ K105 is de-energized
→ K105C is opened
→ K109 is de-energized

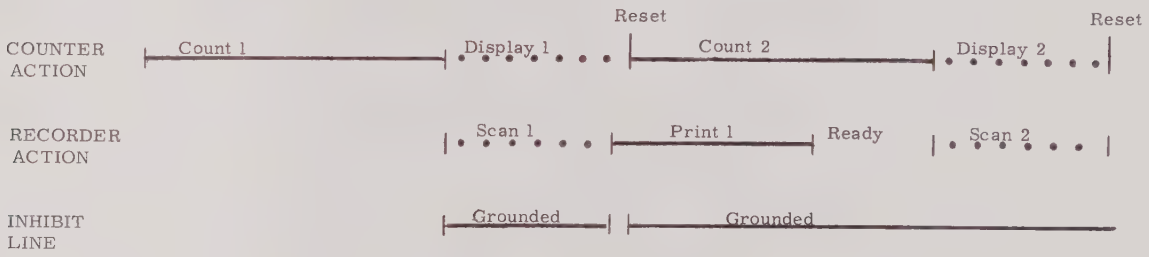
$7A_2$ The sequence is repeated from step 2.

A WHEN THE COUNTER RESETS DURING PRINTING

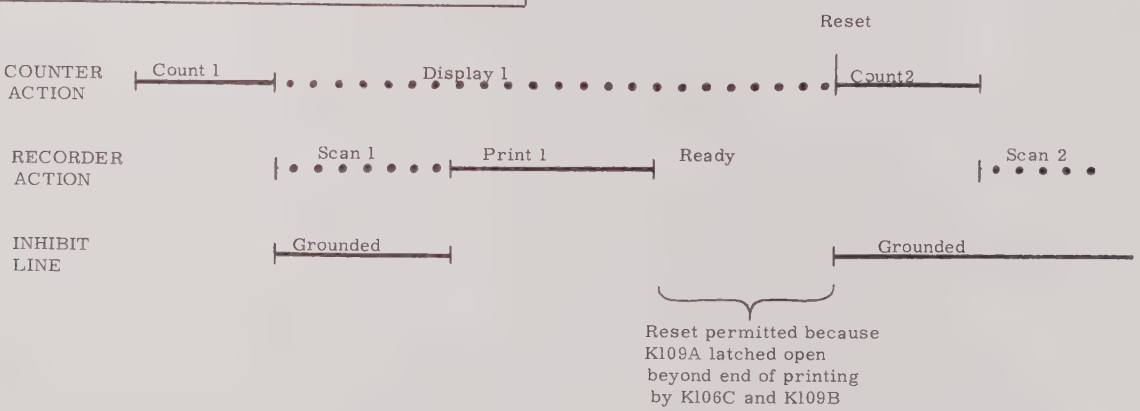
1 WHEN NEXT COUNT ENDS WHILE PREVIOUS COUNT IS BEING PRINTED



2 WHEN PRINTING ENDS DURING THE NEXT COUNT



B WHEN PRINTING ENDS BEFORE THE COUNTER RESETS



NOTE: Time intervals are not drawn to scale

FIGURE 4. TIMING DIAGRAM

ROUTINE MAINTENANCE

Inserting a New Paper Tape. When a new tape is needed procure one meeting the following specifications:

1. Width 2-5/16"
2. Premium grade paper
3. Lint free

The paper must be of the proper width to be guided straight through the paper guide. Paper that is narrower or wider than the specified width will feed erratically from side to side. The better the grade of paper the better the print, but in addition, a premium grade of paper will have the right surface to aid the feed roller and eliminate the possibilities of figures piling. Above all, the paper must be lint free, as lint from a poor quality of paper will settle in the mechanism of the machine, particularly in the motor.

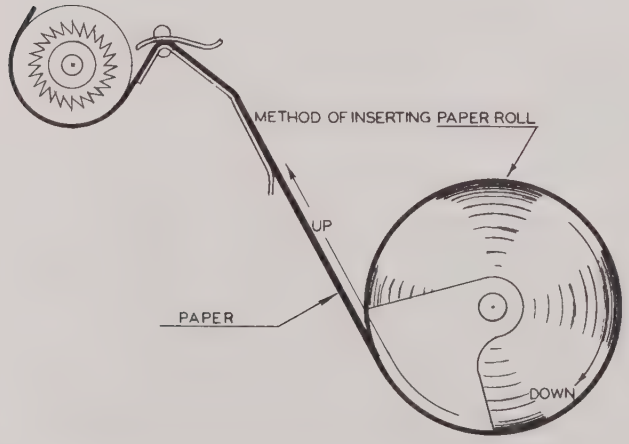


FIGURE 5.
METHOD OF FEEDING PAPER

Not only is the lint harmful to the equipment, but quite frequently it will cause the motor to stop operating. To insert the paper roll, remove the old roll by squeezing the ends of the mandrel (the axle on which the paper roll turns) and pull the mandrel out. Throw core of the old roll away, slip the mandrel through the core of the new roll, and place the mandrel back in its original position. Be sure to insert the new roll so that the paper unwinds from the bottom of the roll, then feeds behind the paper feed bar, over the paper roll and around the roller as illustrated. The paper may be most easily fed into the machine if it is folded to form a point. The paper can be fed through the opening on the top cover.

Replacing the Printer Ribbon. When the inked ribbon in the printer wears out it should be replaced by another meeting the following specifications:

1. Width 5/16"
2. Medium inked
3. Bound edge

If the ribbon does not have the proper width, it will not center on the ribbon guides, resulting in wrinkling and creasing. This could cause the Printer to fail to record the figures on the paper tape. A lightly inked ribbon will necessitate replacement of the ribbon within a very short period. If the ribbon is too heavily inked, the excess ink will deposit on the type face, eventually clogging them in their combs, and the correct figures will not be registered on the tape. A loose edge ribbon is very susceptible to fraying, as its edges are not protected. Ribbon fragments dropping into the mechanism could cause misperformance and serious damage to the equipment. To prevent this, always use a bound edge ribbon.

Also, the ribbon spool must be identical to the original spools furnished with the Recorder so that the ribbon will feed and reverse properly.

To change the ribbon:

1. Open the cabinet cover.
2. Pull the right hand spool off the spindle. Leave the left hand spool on the machine but pull off old ribbon from the left hand spool and throw away old right spool.
3. Place the new ribbon and spool on the right spindle, taking care that one of the extrusions on the inside of the spool fits over the driving lug on the spool holder.
4. Unroll approximately 1 foot of ribbon off the right spool. Bring the ribbon behind the right ribbon guide roller, over the top of the roller, then over the right ribbon guide bracket and straight across the machine to the top of the left ribbon guide bracket.

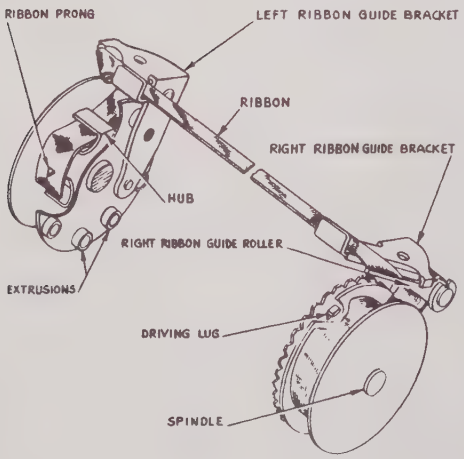


FIGURE 6. RIBBON FEED

5. Now bring it around the left ribbon guide bracket and over and behind the left ribbon guide roller. Attach the free end of the new ribbon to the left spool by feeding it (from the back) through the hub as illustrated in figure 6, and then force the sharp ribbon prong on the spool through the fabric of the ribbon. This operation may be facilitated by removing the left ribbon spool from the machine. However, make sure that it is replaced securely.

Lubrication. The importance of good and frequent lubrication of mechanical equipment cannot be overstressed. This is particularly true of the mechanical printer unit which operates at high speeds. Good and frequent lubrication should not be interpreted to mean excessive lubrication. It is only necessary that one or two drops of oil or grease be applied to all lubrication points. Also, it is important that the best grade of lubricants obtainable be used to insure maximum performance of your equipment. There are two lubricants required for the mechanical printer-graphite grease and oil.

All principal lubrication points and the type of lubricant to be used are called out in Figures 8, 9 and 10. Oil or grease each location pointed out by the arrow after each 100 rolls of tape have been used. After each 500 rolls of tape, oil the motor through the small hole located at each end of the motor housing and all moving parts and springs not called out in the illustrations. The machine and motor should be lubricated every four months, even though less than 100 rolls of tape has been used.

The following lubricants, or their equivalents, are recommended for use in the Berkeley Printer:

1. Victor Graphite Grease #4
2. Victor General Purpose Oil #205

Lubricate the points called-out in figures 7, 8 and 9 after every 100 rolls of tape have been used. After every 500 rolls of tape, oil all other moving parts, including the motor bearings. A small hole at each end of the motor housing connects to the bearing surfaces. Regardless of the amount of use, lubricate all moving parts every four months. Recommended lubricants are Victor Graphic Grease #4 and Victor General Purpose Oil #205.

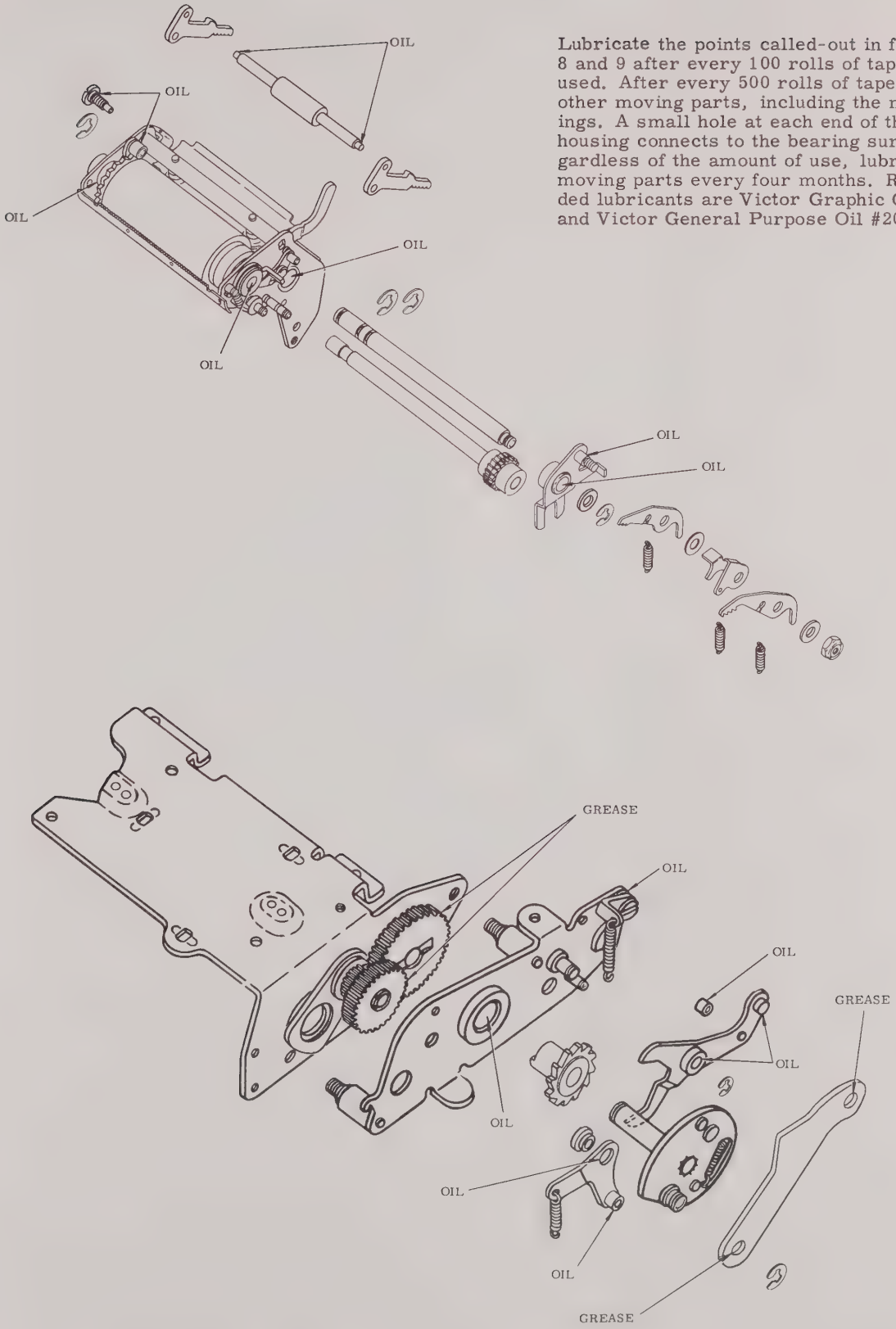


FIGURE 7. LUBRICATION DIAGRAM

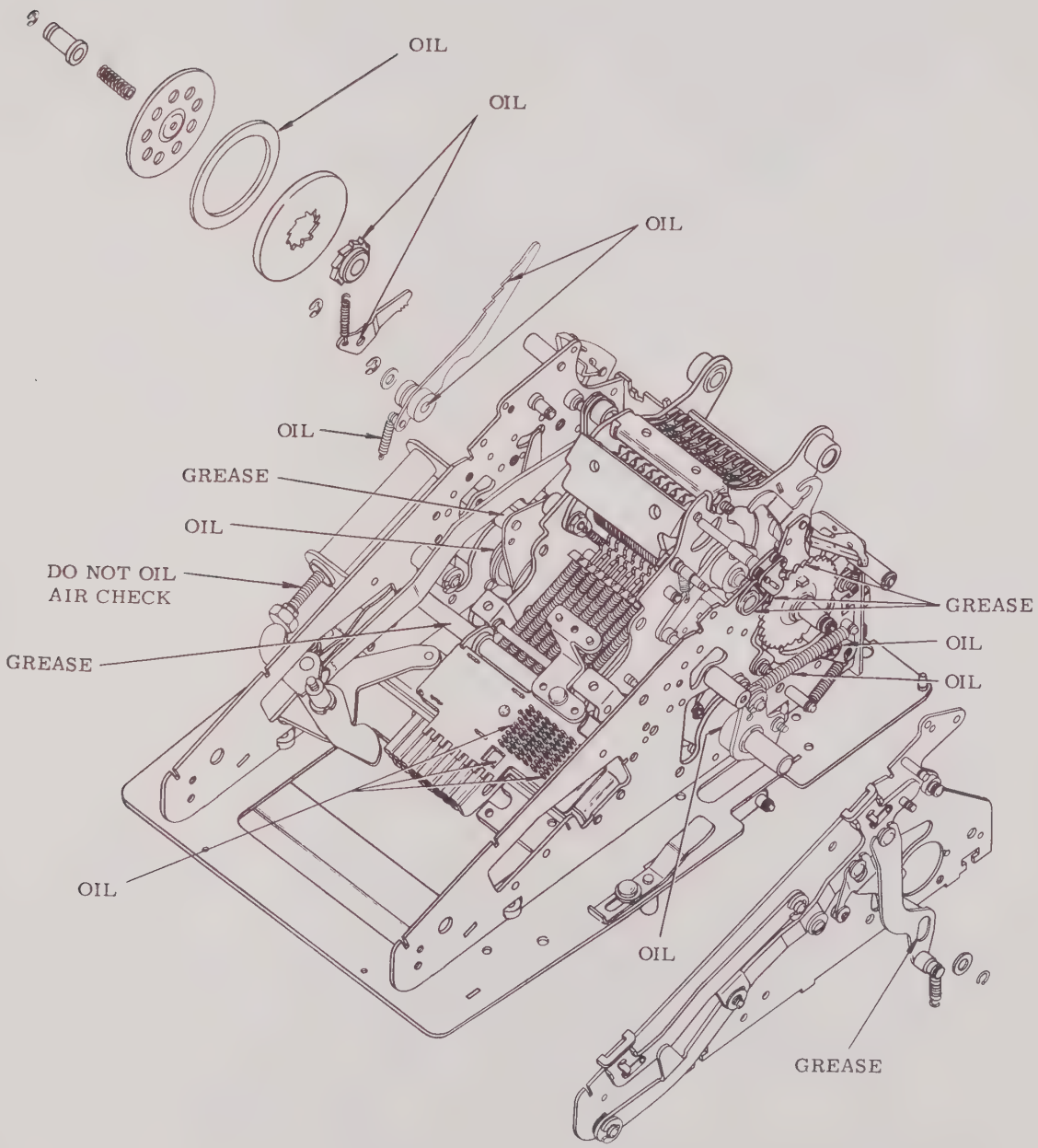
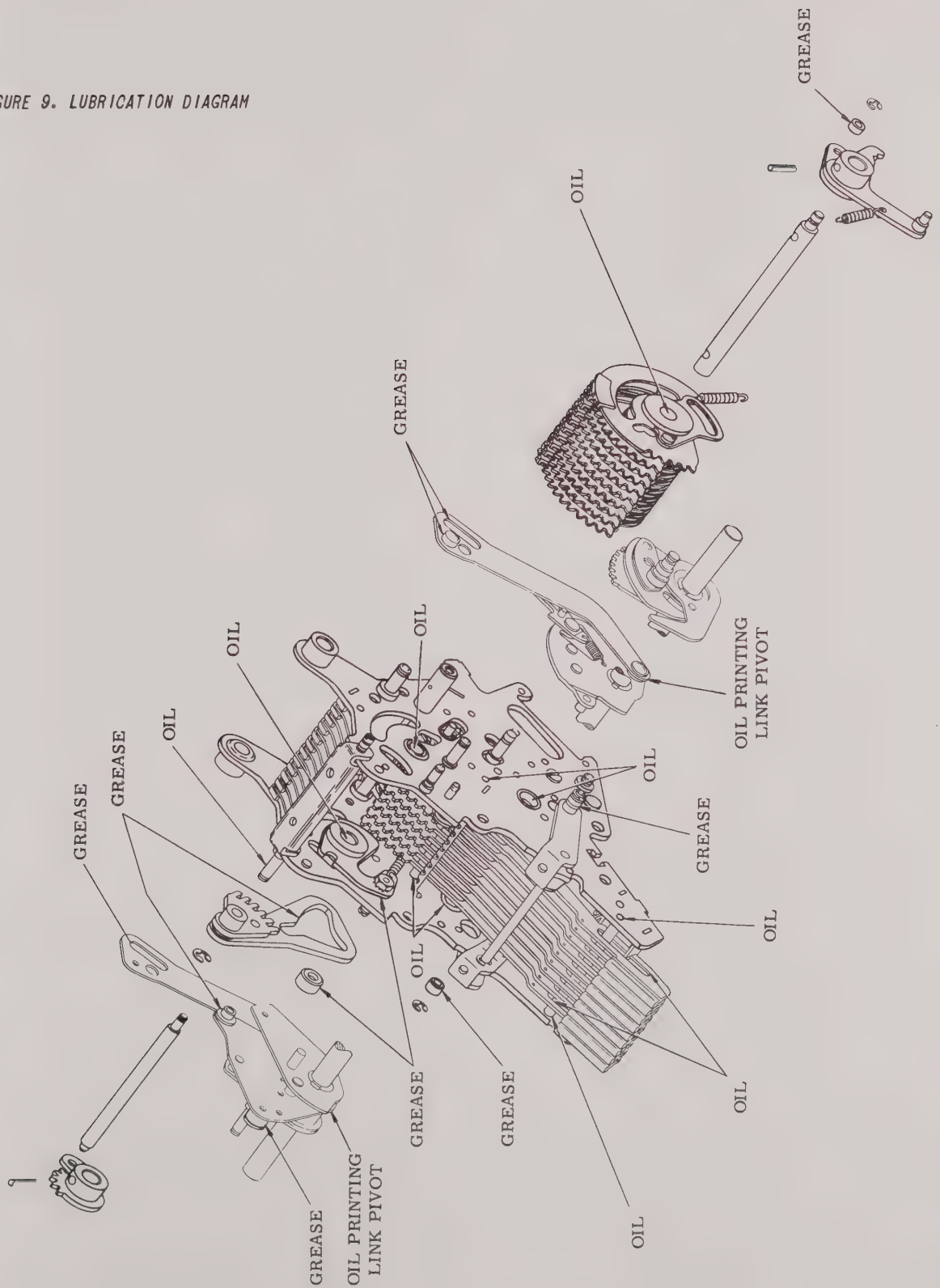


FIGURE 8. LUBRICATION DIAGRAM

FIGURE 9. LUBRICATION DIAGRAM



Care of Relays. The relays and stepping switch used in the recorder seldom require adjustment. But heavy use over a long period of time may cause contact wear and loss of spring tension.

Pitted or built-up contacts should be carefully examined before replacing. Do not replace an eroded contact unless it is worn to the base metal. In the case of twin contacts, one contact of each pair may be worn nearly to the base metal before replacement is required. To recondition contacts which are not unduly worn, remove the "build-ups" and clean the pits. This can be accomplished by cleaning the contact burnisher. When burnishing normally open contacts, place the blade of the burnishing tool between the contacts, press them together, and at the same time move the blade back and forth. Rubbing the blade between the contacts two or three times will usually suffice. When burnishing normally closed contacts, the tension of the contacts furnishes sufficient pressure.

If contact troubles cannot be solved by burnishing, clean the contacts with carbon tetrachloride, being careful to keep the cleaning fluid from coming in contact with relay spool heads and insulators. After cleaning, allow the contacts to dry and then burnish them in the manner described above.

To adjust contact pressure, merely bend the contacts until the desired pressure is achieved. But the user should be cautioned never to adjust contact pressure on a relay unless it is certain that the relay is malfunctioning owing to inadequate contact pressure.

Failure of a circuit may be caused by dirt, corrosion, or other foreign matter. Keep the relay cover in place except when servicing a relay or switch, and wipe the inside of the cover with a lint-free rag before replacing it.

The armatures and cores may be cleaned by inserting a clean piece of bond paper between them. Press the armature toward the core and apply a slight amount of pressure, withdrawing the paper at the same time. Repeat this operation until the paper shows no trace of dirt.

TROUBLESHOOTING

A chart of several common failures and their probable causes appears on the following pages. However since the parts of the unit are interrelated in a fairly complex way a failure may occur whose source must be located by the general procedure outlined below.

First determine the exact symptoms; for example, recorder does not energize; stepping of stepping switch never starts or stops; the printer prints a wrong number of "00" instead of the reading; the basic counter takes two counts during printing; some relay "buzzes" on short time bases; etc. Check such general causes of trouble as line voltage too low, fuse blown, no voltage from power supply, loose plug, no signals from the basic counter, trouble in the basic counter, etc. Often the trouble can be cured by cleaning all relay contacts with a contact burnishing tool.

The most efficient troubleshooting method is to successivly eliminate possible causes until the trouble is tracked to the defective part. If the trouble is in the control circuitry find which relay coils and contacts must be functioning correctly to permit the cycle of operation to go as far as it does. It is fairly safe to assume that these coils and contacts are not the source of trouble. Don't neglect the possible effects of any parallel path which may exist.

Guard against assuming without proof that any component is operating properly. This is one of the greatest pitfalls in troubleshooting. Determine exactly which components are involved in the portion of the cycle at fault. Refer to the chart of operational sequence for aid in determining which parts function at any given time. Sometimes two contacts in series must be closed to energize a coil. If the path to a coil is closed then the coil itself may be open or shorted or the rectifier across it may be shorted. Often the trouble can be traced to a break in some chain of operation by slipping a piece of paper between the contacts of some relay in the chain, and observing whether incorrect operation continues. Check continuity of a path with an ohmmeter. If, for instance, the stepping switch cycles without causing the printer to operate, then the chain which causes the printer motor to be energized must be broken somewhere.

If wrong numbers are printed, check the decoding chain. In order for a number to be entered into the printer the four line code from the DCU in the basic counter must pass correctly through a socket and plug, a cable, the contacts of the stepping switch, the buffer tubes, the relay matrix, and the connection to the proper solenoid. The solenoid must be in working order and energy must be applied by K108 at the proper time. Replace the buffer tube if a relay fails to energize when the grid is at ground potential. Note that the printer always prints "00" if no numbers or all zeros are entered.

GENERAL TROUBLESHOOTING CHART

Symptom	Possible Causes and Remedies
Recorder won't cycle	1. V101 defective. Replace. 2. Improper voltage swing from basic counter. This voltage should be sufficient to cause V101 Triode to become conducting in the "high" state and to cause it to be cut-off in the low state. 3. K106 not closing. Check relay coils and/or contacts. 4. Stepping switch coil open. 5. K108 contacts or coil defective.
Unit continues to cycle or cycles more than once for each printing.	1. Mechanical bind print in solenoid or mechanical linkage to print bar of adding machine. 2. Dirty contacts or decoder relays (K101, K102, K103, K104). Clean. 3. Bad tube V103 or V104. Replace.
Improper printing	
(a) Digits in one column	Improper voltages from readout DCU controlling that column.
(b) Particular digits, e.g. 2.	1. Solenoid coil open. Replace. 2. Pitted contacts on K101, K102, K103 or K104. Clean contacts. 3. Bad V102 or V103. Replace. 4. Mechanical bind in solenoid plunger.
	4. Speed of print motor too high. Speed should be set to between 220 to 230 printings per minute at 130v line. This is a factory adjustment made by adjusting the set screw on the print motor centrifrugal switch with the print bar held down.

ADJUSTING PRINTER SOLENOIDS

Figure 10 is a cross-sectional view of one of the printer solenoids which enter digits into the modified adding machine by depressing the keys. When the solenoid is energized the plunger (consisting of shaft 5, nut 1 and sleeve 3) moves downward, depressing the key of the adding machine until the plunger is halted when sleeve (3) strikes brass washer (4). The length of the plunger stroke can be adjusted by screwing sleeve (3) with respect to shaft (5).

To adjust the plunger stroke proceed as follows:

1. While holding nut (1) with 1/4" open end wrench, loosen set screw (2) with #5 Allen wrench. This makes it possible to change the length of the stroke by rotating sleeve (3) while holding nut (1) stationary. Clockwise rotation shortens the stroke; counter-clockwise rotation lengthens the stroke.
2. "Cock" the machine so that it is in position to enter seven digits. To try out the action, slowly depress and release the plunger seven times. Unless the stroke is too short, a click will be heard, indicating that a digit has been entered, hear the end of each downward movement. The plunger must travel a little bit farther to enter each successive digit; consequently, the seventh digit requires the longest stroke. The object of adjustment is to make the stroke long enough to enter all digits dependably, but not so long that the plunger pounds the plastic key against the plate beneath it or that the sleeve protrudes too far out of the coil, thus weakening the magnetic linkage and the force exerted on the key. To accomplish this objective, first adjust the length of the stroke so that the seventh digit is entered just as the plunger comes to a stop. Then, to make sure that the action will not fail, lengthen the stroke a little more by rotating the sleeve one-half turn counter-clockwise. Take note of how far the plunger moves after entering the seventh digit.
3. Tighten set screw (2) lightly while holding plunger sleeve (3) stationary. Then tighten set screw <u>firmly</u> while holding nut (1) with the 1/4" wrench.
4. Observe the action on entering the seventh digit again. Make sure that the length of stroke has not been disturbed by tightening the set screw.

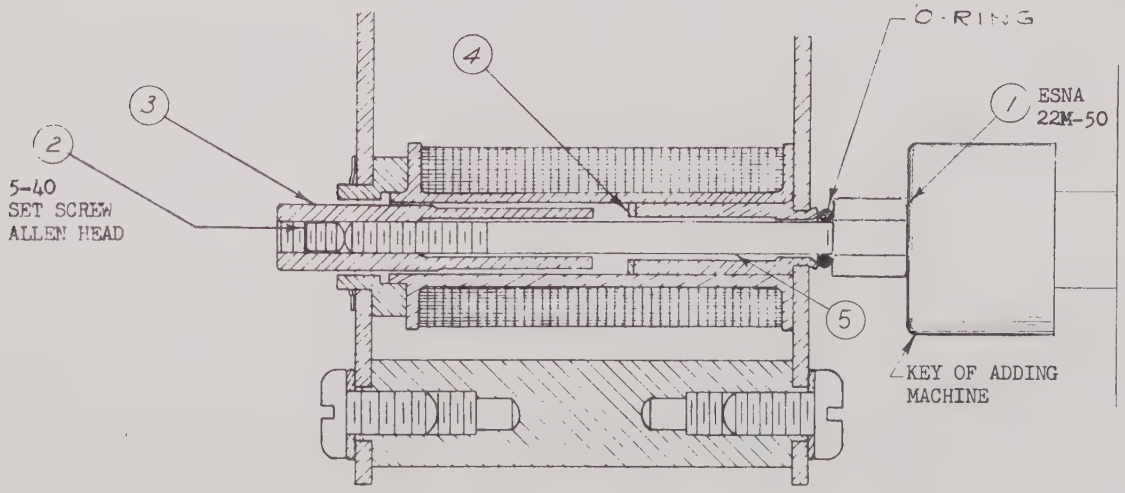


FIGURE 10.

PARTS LIST

Introduction. This list includes all electrical parts likely to require replacement except standard fixed composition resistors. These resistors are adequately described on the accompanying schematics.

ENTIRE EQUIPMENT EXCEPT PRINTER

Detail No.	Stock No.	Description	Manufacturer & Manufacturer's No.
C101	2-3943	Capacitor, 0.1μfd, 200V, Paper	CD Tiny Chief
C102	2-2230	Capacitor, .01μfd, Disc	Erie 811
C103	2-2760	Capacitor, 0.25μfd, 400V, Paper	Sangamo 3004025
C104	2-5583	Capacitor, 0.5μfd, 200V, Paper	CD Tiny Chief
C105	2-7195	Capacitor, 4μfd, 200V	Hopkins Eng. 4P2D
C106		Same as C101	
C107	2-2137	Capacitor, 500μμfd, 300V, Mica	Sangamo RR1350
C108 & C109		Same as C101	
C110 & C111		Same as C107	
C112 & C113		Same as C101	
C114		Same as C107	
C115	2-5582	Capacitor, 150μfd, 250V, Electrolytic	Sangamo PL25150
C116		Same as C103	
C117	2-6766	Capacitor, 200μfd, 350V	Mallory FP Type
C118 & C119		Same as C107	
CR101	8-3983	Rectifier, Selenium, 130V RMS	Radio Receptor Co. 8Y1
CR102		Same as CR101	
CR103	8-2224	Rectifier, Selenium, 130V RMS, 65MA	Radio Receptor Co. 8J1
CR115		Same as CR101	
CR116	8-4425	M500	Sarkes Tarzian
CR117 & CR118		Same as CR116	
F101	7-4127	Fuse, 1.5A, 125V, Slo Blo	
F102		Same as F101	
I101	21-1677	Pilot Lamp, 6-8V, 15 Amp, Bayonet	GE #47
J101	17-3185	AC Receptacle, AC Motor, Base Plug W/ Gnd	Hubbell 7486
J102	17-8094	Connector, 20 Pin, Female	Elco Varicon, RF12020-4
K107	16-2717	Relay, Stepping	

Detail No.	Stock No.	Description	Manufacturer & Manufacturer's No.
P101	17-5593	Connector, 40 Pin, Male	Cannon DPX-40-33P
P103	17-6232	Connector, 16 Pin, Female W/Hood & Side Cable Clamp	Elco Varicon, RF11655
R114	1-2924	Resistor, 200Ω, 10W, WW	Tru-Ohm
R124	1-3388	Resistor, 500Ω, 20W, WW	Tru-Ohm
S101	12-1909	Switch, DPDT	
S102	12-1642	Switch, DPST	
T101	6-4812	Transformer, Power	
V101	5-7562	Tube, 6DJ8	
V102 & V103		Same as V101	
Z101	19-4294	Line Filter, 2x1 Amps at 125V/400 CPS, 400V, DC	Sprague #17957
	24-2798	Box Connector	
	10-6506	Power Cord	
	18-3093	1-2-2-4 Code Relay Package	
	18-6828	Solenoid Assembly	
	18-3091	Control Relay Package	

PRINTER

The Printer is a Special Model 7-58-54-184 Victor adding machine made for Berkeley with the following additional changes:

(1) Compression Springs (Key Springs) have been replaced by Victor part number 4314.

(2) Keys 4, 5 and 6 have been replaced by shallow recess keys.

Parts List 19

Modifications

Schematic Diagram, All Circuitry Except Power Supply, Dwg. No. 1452 D 201

Schematic Diagram, Power Supply Dwg. No. 1452 B 202

SPARE PARTS LIST

RECOMMENDED SPARES FOR 2000 HRS. OPERATION

EQUIPMENT MODEL 1452
CAT. NO. 050-400572
LOT 44

ITEM NO.	REFERENCE DESIGNATION	INV.	BECKMAN INST. PART NO.	ITEM NAME AND DESCRIPTION	A TYPICAL MFR. & NO.		QTY./ EQUIP.	REC. SPARES	UNIT PRICE	EXTENDED PRICE
0001		20	132-402471	PLUG RETAINING CLIP	BECKMAN	132-402471	1	0	1.50	
0002		20	160-400680	SPACER	BECKMAN	160-400680	4	0	.20	
0003		20	175-010426	"O" RING	NATIONAL	622701	11	0	.20	
0004		20	303-001878	WRENCH	MARWEDEL	1116	1	0	1.40	
0005		20	303-041847	ALLEN-WRENCH, NO. 5			1	0	.20	
0006	R119	20	601-002211	RESISTOR, FIXED, COMP, 100K, 1/2W, 10%	ALLEN BRD	EB1041	1	1	.20	.20
0007	R102	20	601-008067	RESISTOR, FIXED, COMP, 150 OHMS, 1/2W, 10%	ALLEN BRD	EB1511	4	2	.20	.40
0008	R104			SAME AS ITEM 0007						
0009	R105			" " " "						
0010	R122			" " " "						
0011	R106	20	601-008076	RESISTOR, FIXED, COMP, 1 K, 1/2W, 10%	ALLEN BRD	EB1021	1	1	.20	.20
0012	R107	20	601-008089	RESISTOR, FIXED, COMP, 12K, 1/2W, 10%	ALLEN BRD	EB1231	1	1	.20	.20
0013	R109	20	601-008097	RESISTOR, FIXED, COMP, 68K, 1/2W, 10%	ALLEN BRD	EB6831	4	2	.20	.40
0014	R110			SAME AS ITEM 0013						
0015	R111			" " " "						
0016	R112			" " " "						
0017	R118	20	601-008106	RESISTOR, FIXED, COMP, 470K, 1/2W, 10%	ALLEN BRD	EB4741	2	1	.20	.20
0018	R123			SAME AS ITEM 0017						
0019	R117	20	601-015052	RESISTOR, FIXED, COMP, 10K, 1/2W, 5%	ALLEN BRD	EB1035	1	1	.20	.20
0020	R125	20	601-015074	RESISTOR, FIXED, COMP, 100K, 1/2W, 5%	ALLEN BRD	EB1045	1	1	.20	.20
0021	R115	20	601-015085	RESISTOR, FIXED, COMP, 390K, 1/2W, 5%	ALLEN BRD	EB3945	1	1	.20	.20
0022	R120	20	601-042992	RESISTOR, FIXED, COMP, 100K, 1W, 10%	ALLEN BRD	GB1041	1	1	.20	.20
0023	R101	20	601-043208	RESISTOR, FIXED, COMP, 8.2K, 1W, 5%	ALLEN BRD	GB8225	3	1	.20	.20
0024	R103			SAME AS ITEM 0023						
0025	R108			" " " "						

SPARE PARTS LIST

RECOMMENDED SPARES FOR 2000 HRS. OPERATION

EQUIPMENT MODEL 1452
CAT. NO. 050-400572
LOT 44

ITEM NO.	REFERENCE DESIGNATION	INV.	BECKMAN INST. PART NO.	ITEM NAME AND DESCRIPTION	A TYPICAL MFR. & NO.		QTY./ EQUIP.	REC. SPARES	UNIT PRICE	EXTENDED PRICE
0026	R113	20	601-065590	RESISTOR, FIXED, COMP, 10 OHM, 1W, 10%	ALLEN BRD	GB1001	2	1	.20	.20
0027	R126			SAME AS ITEM 0026						
0028	R116	20	601-800018	RESISTOR, FIXED, COMP, 10 OHMS, 1/2W, 10%	ALLEN BRD	EB1001	1	1	.20	.20
0029	R124	20	604-815591	RESISTOR, FIXED, WW, 500 OHMS, 20W, 10%	TRU-OHM	FRL20-501K	1	1	.60	.60
0030	R114	20	604-800934	RESISTOR, FIXED, WW, 200 OHMS, 10 W, 10%	TRU-OHM	FRL10-201K	1	1	.90	.90
0031	C115	20	631-802955	CAPACITOR, FIXED, ELECT, 150 MF, 250V	SPRAGUE	TVL-1540	1	1	2.65	2.65
0032	C117	20	631-802976	CAPACITOR, FIXED, ELECT., 200 MF, 350V	MALLORY	FP330	1	1	2.20	2.20
0033	C102	20	633-804718	CAPACITOR, FIXED, CERAMIC, .01 MFD, 600V	ERIE	811-.01	1	1	.20	.20
0034	C107	20	637-804777	CAPACITOR, FIXED, MICA, 500 MMFD, 500V, 5%	SANGAMO	RR1350	6	1	.30	.30
0035	C110			SAME AS ITEM 0034						
0036	C111			" " " "						
0037	C114			" " " "						
0038	C118			" " " "						
0039	C119			" " " "						
0040	C105	20	639-804881	CAPACITOR, FIXED, PAPER, 4 MF, 200V, 5%	HOPKINS	4P2D	1	1	3.10	3.10
0041	C103	20	639-804917	CAPACITOR, FIXED, PAPER, .25MFD, 400VDC	SANGAMO	3304025	2	1	.30	.30
0042	C116			SAME AS ITEM 0041						
0043	C104	20	639-817628	CAPACITOR, FIXED, PAPER, .47 MFD, 200VDC	SPRAGUE	67P47402	1	1	.40	.40
0044	C101	20	639-817629	CAPACITOR, FIXED, PAPER, .1 MF, 200VDC	SANGAMO	330201	6	2	.20	.40
0045	C106			SAME AS ITEM 0044						
0046	C108			" " " "						
0047	C109			" " " "						
0048	C112			" " " "						
0049	C113			" " " "						
0050		20		CORDSET, ELECT. POWER, 3 COND. BLK, FT.	BECKMAN		1	0	4.00	

SPARE PARTS LIST

RECOMMENDED SPARES FOR 2000 HRS. OPERATION

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CAT. NO. 050-400572
LOT 44

ITEM NO.	REFERENCE DESIGNATION	INV.	BECKMAN INST. PART NO.	ITEM NAME AND DESCRIPTION	A TYPICAL MFR. & NO.		QTY./ EQUIP.	REC. SPARES	UNIT PRICE	EXTENDED PRICE
0051	J103	20	672-806799	CONNECTOR, RECEPTACLE, MALE, 16 PINS	ELCO	RM11650-3	1	1	1.50	1.50
0052	P103	20	672-806800	CONNECTOR, PLUG, FEMALE, 16 CONTACTS	ELCO	RF11655	1	1	1.90	1.90
0053	P101	20	672-806831	CONNECTOR, PLUG, MALE, 40 PINS	CANNON	DPX-40-33P	1	1	4.50	4.50
0054	P102	20	672-807962	CONNECTOR, PLUG, MALE, 20 CONTACTS	ELCO	RM12020-4	2	1	1.40	1.40
0055	P104			SAME AS ITEM 0054						
0056	J102	20	672-807963	CONNECTOR, RECEPTACLE, FEMALE, 20 PINS	ELCO	RF12020-4	2	1	1.30	1.30
0057	J104			SAME AS ITEM 0056						
0058		20	691-808808	TERMINAL BLOCK, BARRIER, 3 TERMINALS	JONES	3-140Y	1	0	.30	
0059		20	697-400681	CONNECTING ROD	BECKMAN	697-400681	11	1	.30	.30
0060		20	697-806983	CLAMP, CABLE, W/BUSHING	CANNON	MS3057-10A	1	1	.40	.40
0061		20	697-807054	HOOD, CONNECTOR, FOR DPX CONNECTORS	CANNON	DPX-CG25/32	1	1	1.70	1.70
0062		20	699-801709	NUT, COUPLING, 1-20 THREAD	CANNON	AN 3066-10	1	0	.60	
0063		20	699-807589	BOX CONNECTOR, 1-20 THREAD	CANNON	AN 3064-10	1	0	.90	
0064	S102	20	701-806031	SWITCH, TOGGLE, DPST, 3 AMP AT 250 VAC	CUTLER HAM	8370K8	1	0	1.40	
0065	S101	20	701-806040	SWITCH, TOGGLE, DPDT, 3 AMP AT 250 VAC	CUTLER HAM	8373K8	1	0	1.50	
0066	K107	20	716-401905	SWITCH, STEPPING	BECKMAN	716-401905	1	1	37.25	37.25
0067	K101	20	718-401883	RELAY, 4 FORM C, 10K COIL	BECKMAN	718-401883	5	1	9.00	9.00
0068	K103			SAME AS ITEM 0067						
0069	K104			" " " "						
0070	K106			" " " "						
0071	K109			" " " "						
0072	K105	20	718-401884	RELAY, 2 FORM C, 10K COIL	BECKMAN	718-401884	2	1	9.00	9.00
0073	K108			SAME AS ITEM 0072						
0074	K102	20	718-401891	RELAY, 1 FORM C, 10K COIL	BECKMAN	718-401891	1	1	5.25	5.25
0075	F101	20	731-801567	FUSE, ELECTRICAL, 1.5 AMP, 125V, TIME DELAY	LITTLEFUSE	313	2	10	.30	3.00

SPARE PARTS LIST

RECOMMENDED SPARES FOR 2000 HRS. OPERATION

EQUIPMENT MODEL 1452
CAT. NO. 050-400572
LOT 44

ITEM NO.	REFERENCE DESIGNATION	INV.	BECKMAN INST. PART NO.	ITEM NAME AND DESCRIPTION	A TYPICAL MFR. & NO.		QTY./ EQUIP.	REC. SPARES	UNIT PRICE	EXTENDED PRICE
0076	F102			SAME AS ITEM 0075						
0077	XF101	20	735-007268	FUSEHOLDER, 15 AMP AT 250V	BUSSMAN	HKP	2	0	.30	
0078	XF102			SAME AS ITEM 0077						
0079	XCR116	20	735-023745	RECTIFIER HOLDER, DUAL	LITTLEFUSE	099063	1	0	.30	
0080	XCR117	20	735-024849	RECTIFIER HOLDER, SINGLE	LITTLEFUSE	099062	1	0	.20	
0081	V101	20	751-800237	ELECTRON TUBE, DUOTRIODE, TYPE 6DJ8	AMPEREX	6DJ8	3	6	2.60	15.60
0082	V102			SAME AS ITEM 0081						
0083	V103			" " " "						
0084	CR116	20	755-023744	DIODE, CRYSTAL RECTIFYING	SARKES T	M500	3	12	1.65	19.50
0085	CR117			SAME AS ITEM 0084						
0086	CR118			" " " "						
0087	Z101	20	771-802470	FILTER, LINE	SPRAGUE	17957	1	1	9.50	
0088	CR101	20	774-023908	RECTIFIER, METALLIC, HALF-WAVE	RADIO REC	8Y1	14	2	.80	1.60
0089	CR102			SAME AS ITEM 0088						
0090	CR115			" " " "						
0091	CR121			" " " "						
0092	CR122			" " " "						
0093	CR123			" " " "						
0094	CR124			" " " "						
0095	CR125			" " " "						
0096	CR126			" " " "						
0097	CR127			" " " "						
0098	CR128			" " " "						
0099	CR129			" " " "						
0100	CR130			" " " "						

SPARE PARTS LIST

RECOMMENDED SPARES FOR 2000 HRS. OPERATION

EQUIPMENT MODEL 1452
CAT. NO. 050-400572
LOT 44

ITEM NO.	REFERENCE DESIGNATION	INV.	BECKMAN INST. PART NO.	ITEM NAME AND DESCRIPTION	A TYPICAL MFR. & NO.		QTY./ EQUIP.	REC. SPARES	UNIT PRICE	EXTENDED PRICE
0101	CR131			SAME AS ITEM 0088						
0102	CR103	20	774-808178	RECTIFIER, METALLIC, HALF-WAVE	REDIO REC	8J1	1	1	1.00	1.00
0103		20	789-401871	SOLENOID	BECKMAN	789-401871	11	1	1.25	1.25
0104	T101	20	792-401904	TRANSFORMER, POWER	BECKMAN	792-401904	1	1	10.00	10.00
0105		20	855-400705	PRINTING MACHINE	BECKMAN	855-400705	1	0	297.50	297.50
0106	XI101	20	824-801191	LAMPHOLDER, W/GREEN LENS	DIALIGHT	81410-432	1	0	.65	
0107	I101	20	825-063063	LAMP, INCANDESCENT, MIN. BAYONET BASE	GEN ELECT	47	1	3	.20	.60
0108	XV101	20	860-802336	SOCKET, TUBE, 9 PIN, SADDLE MTG MINIATURE	ELCO	377BC	3	0	.20	
0109	XV102			SAME AS ITEM 0108						
0110	XV103			" " " "						

MODIFICATION A

Modification A adds a feed and storage box, which accommodate an accordian folded tape. Tape so folded is easily stored and count information for any period may be located quickly by paging through the folded tape as though it were a book. The tape required is only 2-13/32" wide but otherwise identical with the commonly available 2-1/2" reporter size Stenotype tape. Tape trimmed to the proper size may be purchased from Berkeley at 50 cents a pad. The reporter size Stenotype tape may be obtained from Stenotype Machines, 318 So. Michigan, Chicago, Ill.

MODIFICATION T

This modification substitutes a relay matrix unit (part no. 18-3092) which enables the printer to operate with a 1-2-4-8 code input. See dwg. 1452 D 401

MODIFICATION H

This modification changes a standard unit to operate from a 220 volt AC line. The modification includes the following changes:

1) A 220:110 volt step-down transformer (part No. 029555) has been added between POWER Switch S102 and transformer T101.

2) The line fuses, F101 and F102, have been changed to 1a.

The modified power supply circuit is shown on dwg. 1452 B 601.

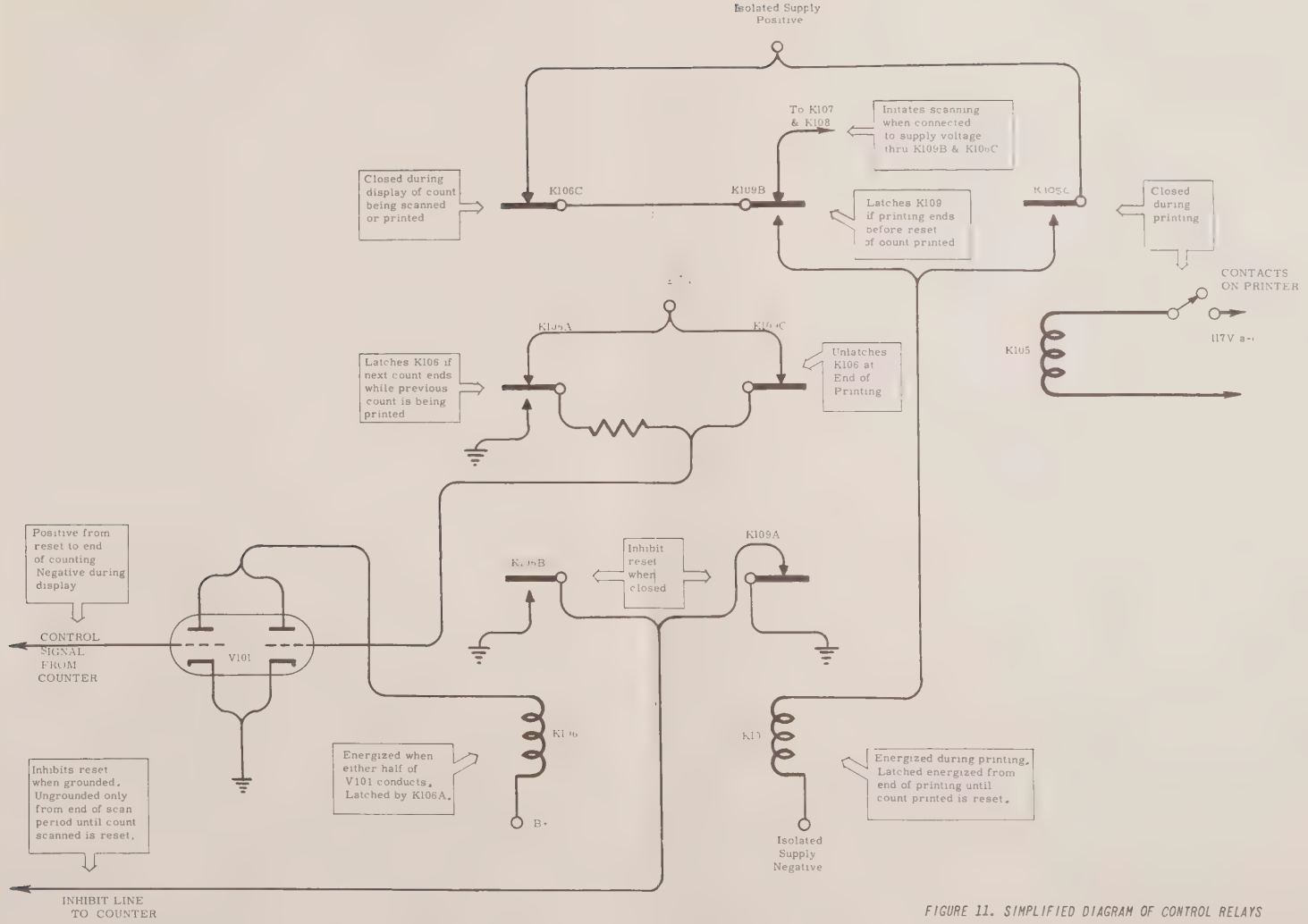
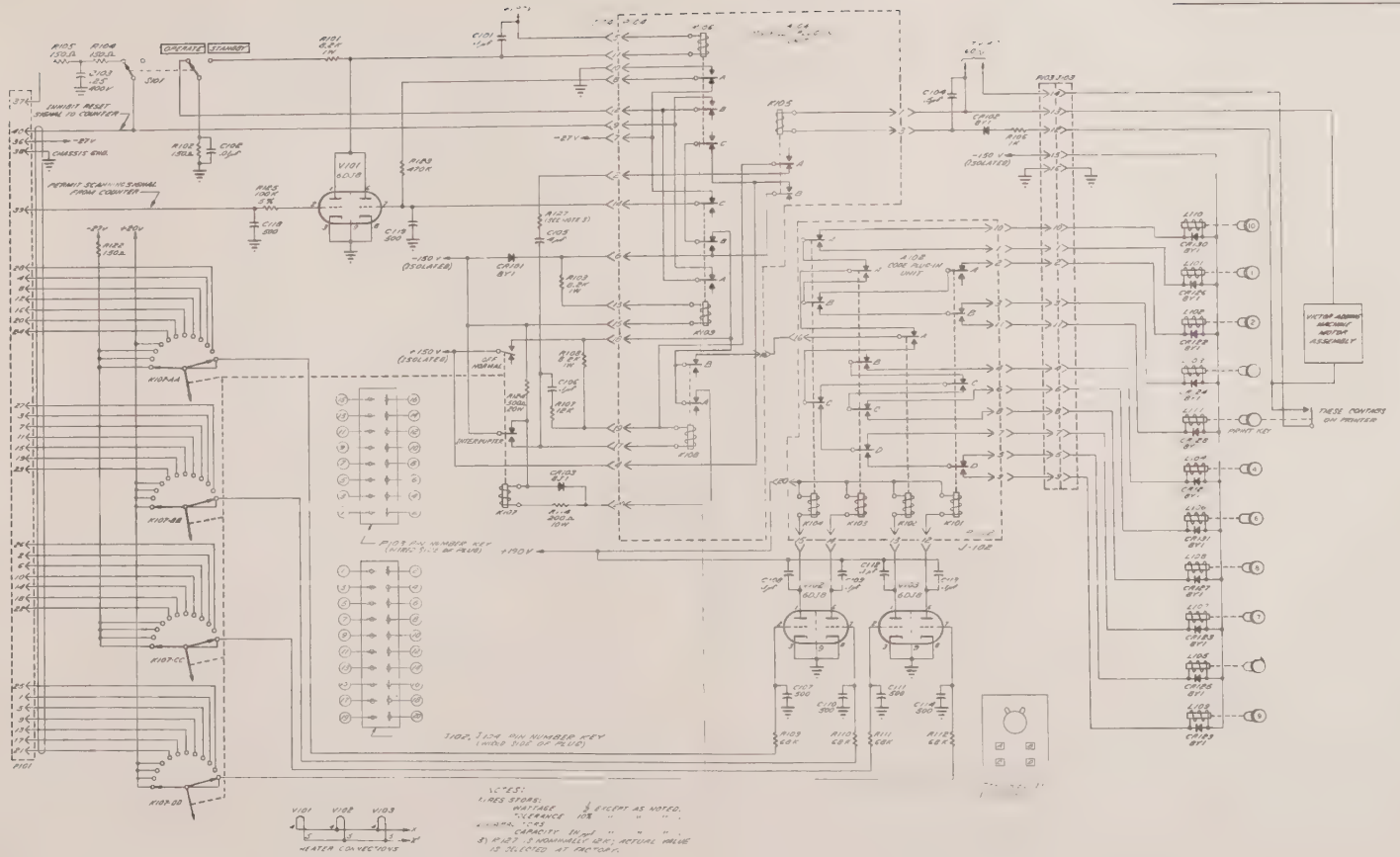

Isolated Supply Positive
To K107 & K108
Initates scanning when connected to supply voltage thru K109B & K106C
Closed during display of count being scanned or printed
K106C
K109B
K105C
Latches K109 if printing ends before reset of count printed
Closed during printing
CONTACTS ON PRINTER
K105
117V a-c
K106A
K106C
Latches K106 if next count ends while previous count is being printed
Unlatches K106 at End of Printing
Positive from reset to end of counting Negative during display
CONTROL SIGNAL FROM COUNTER
V101
K106B
Inhibit reset when closed
K109A
K106
Energized when either half of V101 conducts. Latched by K106A.
B+
K109
Energized during printing. Latched energized from end of printing until count printed is reset.
Isolated Supply Negative
Inhibits reset when grounded. Ungrounded only from end of scan period until count scanned is reset.
INHIBIT LINE TO COUNTER

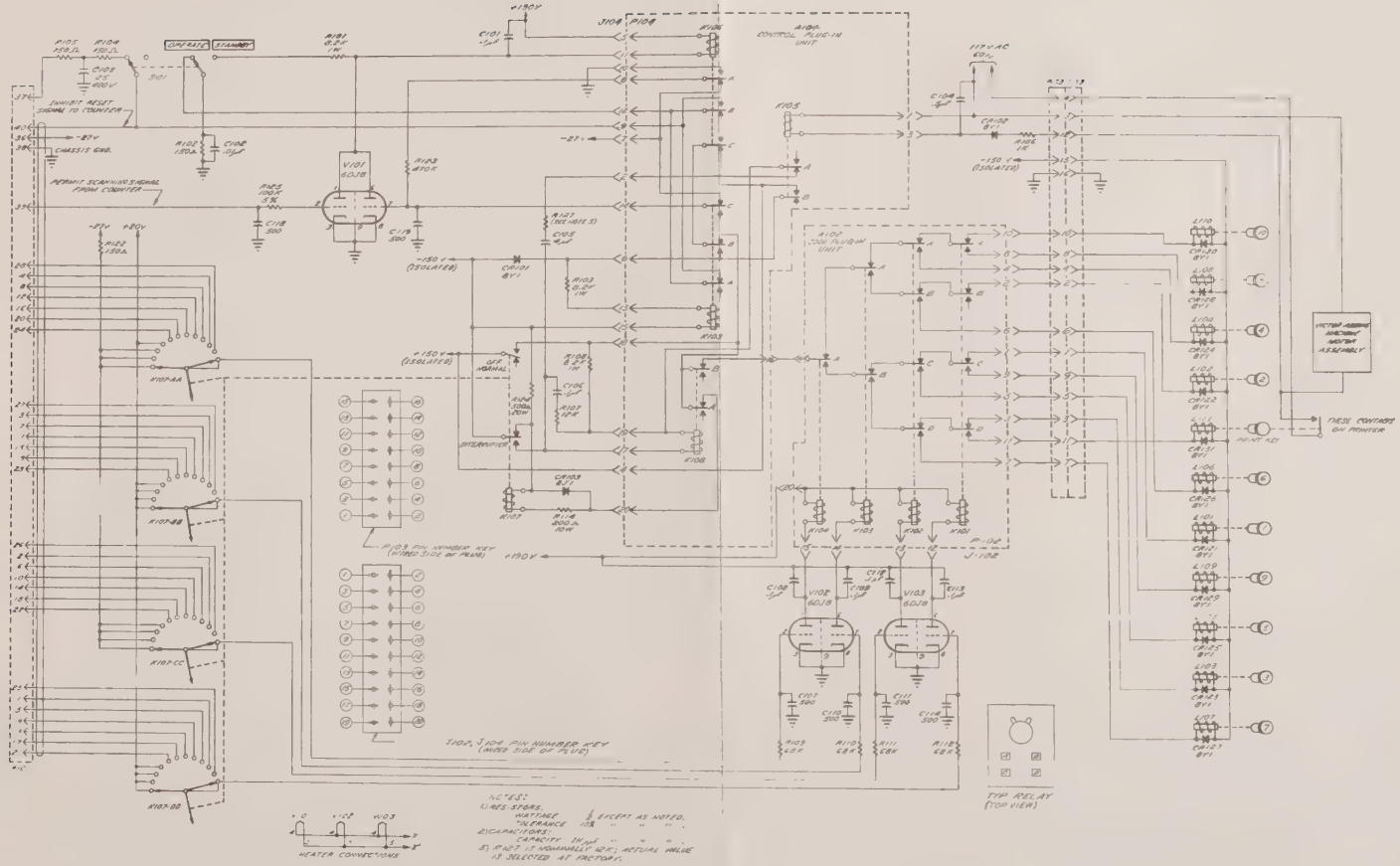
FIGURE 11. SIMPLIFIED DIAGRAM OF CONTROL RELAYS

DIGITAL RECORDER
(1-2-2-4 CODE)
SCHEMATIC DIAGRAM



BECKMAN/BERKELEY DIVISION
DWG. NO. 1452 D 201

DIGITAL RECORDER
(1-2-4-8 CODE)
SCHEMATIC DIAGRAM



NOTES:
1) RESISTORS: WATTAGE ½ EXCEPT AS NOTED. TOLERANCE 10% " " " ".
2) CAPACITORS: CAPACITY IN μf " " " ".
3) R 107 IS NORMALLY 12K; ACTUAL VALUE IS SELECTED AT FACTORY.

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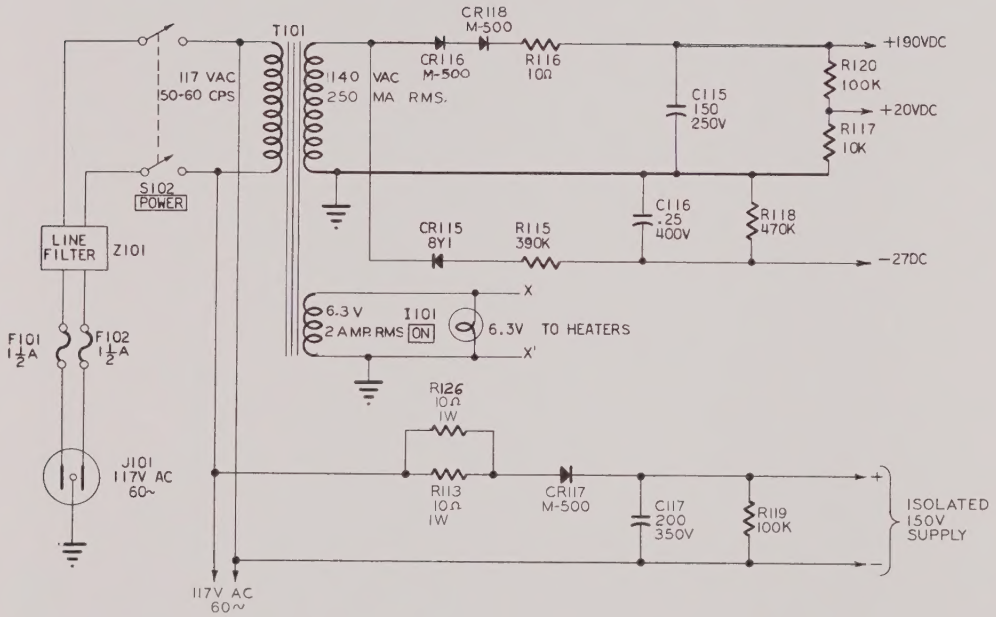
BECKMAN/ BERKELEY DIVISION
DWG. NO. 1452 D 401



NOTE:
RESISTORS:
WATTAGE——— $\frac{1}{2}$ W UNLESS NOTED OTHERWISE.
TOLERANCE——— 10% UNLESS NOTED OTHERWISE.
CAPACITORS:
CAPACITY——— IN μf UNLESS NOTED OTHERWISE.

SCHEMATIC DIAGRAM
POWER SUPPLY
MODEL 1452 RECORDER
DWG. NO. 1452B202

Lot 18

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